1333 Effects of sole and intercropping with cotton on the performance of maize varieties under *Striga* infestation

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Field trials were conducted at Samaru and Bagauda, Nigeria for a two year period (1997 and 1998 rainy seasons) to evaluate the use of cotton trap-crop cultivars in mixture with maize varieties for the management of *Striga hermonthica*. The treatments were made up of five maize varieties in mixture with two cotton cultivars and sole maize as control. The experimental design was split-plot with maize varieties in main plot and cotton trap-crop cultivars in sub-plots, replicated three times. Results at Samaru and Bagauda in 1997 and 1998 showed that the *Striga* tolerant open-pollinated (OP) maize variety Acr.93 TZL comp.1-W and TZL Comp.1C3 and commercial hybrids, Oba supper I and 99022-13 had significantly fewer *Striga* shoots and incidence and produced higher grain yields than the susceptible checks. In 1997 and 1998, at Samaru, maize intercropped with SAMCOT 10 and 9 reduced *Striga* infestation and produced 19% and 12% higher grain yields, respectively than sole maize crop. However, at Bagauda sole maize and intercropped maize with the two cotton varieties did not differ in *Striga* infestation and incidence. Only in 1997 that sole maize produced significantly higher grain yield than the intercrop. In conclusion, improved maize productivity could be achieved through the use of *Striga* tolerant varieties and inter-cropping with promising cotton trap-crop cultivars for the management of *striga*. However, it is suggested that a broader multi-location testing of this management strategy be carried out in order to further validate its wider application.

KEYWORD:Trap-crop, Intercropping, Maize, *Striga* Control

Introduction

The major obstacles to maize production in the West and central African savannas are nitrogen deficiency and *Striga hermonthica* parasitism (Berner and Kling, 1995). *Striga* which is endermic in the African savannas can cause serious devastation to maize especially on the fields of resource-poor farmers. Even under good management conditions about 79% reduction in yield was observed in susceptible hybrid maize (Lagoke *et al.,* 1997). The value of total annual crop loss due to *Striga* in Africa has been estimated at 7 billion US Dollars (M'Boob, 1986).

Traditional African cropping systems which have included prolonged fallow and rotation were common management practices that have been used in the past to improve soil fertility and kept the infestation of *Striga* spp. at tolerable levels. However, increasing human population has resulted in intensive land use and a shift away from traditional cropping systems, which in turn has resulted in the depletion of soil fertility and decrease in *Striga* control (Berner *et al.,* 1996). A number of improved tolerant maize varieties have been developed by IITA. However, for effective management of *Striga* an integration of various control methods in a technological package is mandatory and highly expedient (Lagoke *et al.,* 1997). Intercropping of maize with non-host crops have been reported to increase the efficiency of land use through improved soil productivity and reduction of *striga hermonthica* soil seed bank caused by the stimulation of suicidal germination of *Striga* seeds by non-host cultivars (Lagoke *et al.,* 1997). The spreading vegetation of non-host crops (trap crops) also smoother emerging *Striga* plants (Venon, 1995; Kureh *et al.,* 2000). Varieties of cotton with very high *Striga* seed germination potential have been identified (Lagoke *et al.,* 1997). The objective of the study was to ameliorate yield loss due to *Striga* soil seed bank and seed production through the use of cotton trap-crop in mixture with maize.

Materials and Methods

Field trials were conducted on *Striga* sick fields during the 1997 and 1998 wet seasons at Samaru in the Northern Guinea Savanna (NGS) and Bagauda in the Sudan Savanna (SS) to evaluate the use of non-host crop (Trap-crop) cultivars in mixture with maize varieties for the management of *Striga hermonthica* in maize. The treatments were made up of five maize varieties including three tolerant maize varieties, a susceptible check and a recommended variety for the location in mixture with two cotton cultivars and sole maize as control. The experimental design was split-plot, with maize varieties in main plot and trap-crop cultivars in sub-plots. The treatments were replicated three times.

The fields were ploughed, harrowed and ridged at 75cm width. The fields were further inoculated with about 3,000 germinable *Striga* seeds per hill at about 50cm apart. Maize seeds were planted on the inoculated spots one week later. Intercropped cotton was planted between maize hills on the same day. Spot application of fertilizer was carried out at the rate of 100kg N/ha, 50kg P_2O_5/ha and 50kg K_2O/ha to maize using 20-10-10 compound fertilizer and Urea. The nitrogen fertilizer was split-applied at 3 and 6 weeks after sowing (WAS). The intercropped cotton received a basal application of 20kg N/ha and 50 P_2O_5/ha using urea and single super phosphate. At Samaru, Gramazone at 2.5 a.i kg/ha was applied after planting to control established weeds. At both locations, hoe weeding was carried out at 3 and 5 WAS followed by careful hand-pulling of other annual weeds at 7WAS. The plot sizes were 22.5m^2 and 18.0m^2 at Samaru and Bagauda, respectively in 1997 but in 1998, the plot sizes were 15m^2 and 9m^2 at Samaru and Bagauda, respectively.

Data were collected on *Striga* incidence (crop plants infested), level of infestation (*Striga* shoot count), yield and yield attributes of maize. The data collected were subjected to analysis of variance using the General Linear Model procedure (GLM SAS package (SAS 1999) and means were compared using the standard error of the means.

Results

Maize varieties differed significantly in their reaction to *Striga* and subsequent performance at the two locations. In 1997, at Samaru, in the Northern Guinea savanna, the tolerant open-pollinated (OP) maize variety Acr.93 TZL comp.1-W had fewer *Striga* shoots and incidence and produced 33% higher grain yield than the susceptible check TZESRW. The grain yield of Acr.93 TZL comp.1-W was comparable with other maize varieties tested (Table 1). The OP variety TZBP-SR-W also produced 51% higher maize grain yield than TZESRW, inspite of support for high *Striga* emergence. Maize intercropped with cotton variety, SAMCOT 9 significantly supported fewer *Striga* shoots than sole maize. Maize intercropped with SAMCOT 10 is comparable to both sole maize and maize intercropped with SAMCOT 9 in the number of emerged *Striga* shoots. There was no yield difference between the intercrop and the sole maize.

At Bagauda in the drier savanna with poor soil fertility, the OP maize variety, Acr.93 TZL comp.1-W also had fewer *Striga* shoots and incidence and produced 54% higher grain yield than the susceptible hybrid, 8338-1 (Table 2). Maize hybrids Oba super 1 and 9022-13 also produced higher maize grain yield than the susceptible variety inspite of support for moderate *Striga* infestation and incidence. Sole maize and intercropping maize with the two cotton varieties did not differ in *Striga* infestation and incidence. However, sole maize produced 26.1% and 26.5% higher grain yield than intercropping maize with SAMCOT 9 and SAMCOT 10, respectively.

At Samaru in 1998, the commercial hybrid maize, Oba supper I, had significantly fewer *Striga* shoots and incidence and produced 28% higher grain yields than the susceptible hybrid, 8338-1 (Table 3). Although all the other varieties supported fewer *Striga* shoots and incidence, 9022-13 and TZL comp.1C4 also produced 51% and 36% higher grain yields than the susceptible hybrid. The recommended maize variety TZBP-SR-W actually produced significantly lower yield than the three *Striga* tolerant varieties evaluated in the trial. Maize intercropped with cotton cv. SAMCOT 10, significantly reduced *Striga* infestation on maize compared with cotton cv. SAMCOT 9 and resulted in significantly higher cob yield than the sole maize crop. Maize intercropped with SAMCOT 10 and 9 produced 19% and 12% higher grain yields, respectively than sole maize crop.

At Bagauda, maize variety Mega white supported more *Striga* shoots than 9021-18, TZL comp.1C3 and 8338-1 (Table 4). In spite of low plant count observed with 9022-13, the variety and 9021-18 produced significantly higher cob and grain yields than the other three varieties, 8338-1, TZL comp.1C3 and Mega white. Mega white was obviously susceptible as reflected in support for high *Striga* shoot emergence and production of low grain yield.

Discussion

The open-polliated maize variety Acr.93 TZL comp.1-W and the tolerant hybrids 9022-13 and oba super I exhibited tolerance to *Striga hermonthica* and adapatbility to Northern Guinea savanna and Sudan savanna agroecological zones through the production of acceptable grain yield in spite of support for low to moderate *Striga* emergence in the two years of evaluation. This confirmed the stability of the varieties in their reaction to *Striga* over years and across locations in the northern Guinea savanna and Sudan savanna agroecologies as earlier reported by Lagoke *et al.* (1997). TZL comp.1C4 as well as TZBP-SR-W also exhibited tolerance to *Striga hermonthica* and adaptability to Northern Guinea savanna and Sudan savanna, respectively through the production of high grain yields than the susceptible checks 8338-1 and Mega white in the respective locations. Apparently, these varieties exhibited high tolerance, moderate resistance and adaptability to Northern Guinea savanna and Sudan savanna agro-ecologies, respectively. Ejeta *et al.* (1991) had indicated that genotype x environment interaction largely influence the reaction of varieties to *Striga*. The low yield of 8338-1 despite lower *Striga* emergence confirmed the susceptibility of the variety to *Striga* and that the low emergence could be attributed to underground competition among high population of *Striga*.

The performance of the OP varieties relative to the hybrid 8338-1 is a highly encouraging development in the effort to explore host-plant resistance or tolerance as a component for *Striga* integrated pest management (IPM). Farmers are more likely to be able to adopt and manage the OP's in the *Striga* control packages than the hybrids (Kim, 1991). Once the skill is acquired, farmers can produce their seeds for use in subsequent years rather than relying on seed companies (Kim, 1994; Berner *et al*., 1996; Lagoke *et al.,* 1996).

In all the trials, adequate fertilizer was applied to the varieties. The performance of the varieties is therefore a product of trap-cropping effect, agronomic potentials, tolerance to *Striga* and the environment as earlier suggested by Ejeta *et al*. (1991) and Lagoke *et al.*

(1997). Adetimirin and Kim (1995) reported that more effective reduction in yield loss and *Striga* infestation can be achieved through the application of adequate fertilizers on *Striga* tolerant hybrids.

Inter-cropping maize with cotton cv. SAMCOT 10 depressed *Striga* shoot emergence and caused higher maize grain production at Bagauda and cob yield at Samaru, respectively in 1998. Both these non-host crop cultivars exhibited potential for use as trap-crops for *Striga* management. Earlier reports indicated that intercropping maize with non-host crop cultivars increased the efficiency of land use through reduction of *Striga hermonthica* soil seed bank caused by the stimulation of suicidal germination of *Striga* seeds by non hosts (Lagoke, *et al.*, 1997). Traditional African cropping systems which included rotation and inter-cropping were common management practices in the past that improved soil fertility, kept *Striga* infestation at tolerable levels and increased seed yields and crop values (Berner and Kling, 1995).

Emerged *Striga* plants in the intercrop were etiolated in growth and died earlier than the *Striga* that emerged on the sole crop probably as a result of the smoothering effects of the trap-crops. This finding confirmed earlier reports by Vernon (1995) and Kureh, *et al.* (2000) who found that the spreading vegetation of the non-host crops (trap-crops) also smother emerging *Striga* plants.

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Table 1: Effects of variety and trap-cropping on *Striga* infestation and incidence, yield and yield components of maize at Samaru during the 1997 wet season

Maize varieties	*Striga* count/plot[1]		Crop plant infested /plot		Maize plant Count		Grain yield [Kg/ha]
	12WAS[2]	Harvest	12WAS	Harvest	Cob No/plot	Cob weight (kg/plot)	
9021-18 (Oba super 1)	16.6ab[3]	81.8a	4.5ab	9.4	64.9	5.85a	1623ab
9022-13	11.6ab	17.0ab	4.2ab	7.9	71.4	5.79ab	1635ab
Acr.93TZLComp.1-W	4.2b	9.1b	2.ob	6.2	68.0	4.80a-c	1473ab
TZBP-SR-W	10.7ab	18.7a	4.oab	10.5	68.2	5.51a-c	1665a
TZESRW	21.5a	17.2ab	5.6a	9.1	63.9	4.13c	1106b
SE±	3.31	2.41	0.59	1.29	4.13	0.34	121.69
<u>Trap Crop Cultivars</u>	21.1	11.36b	3.9	6.6	68.8	5.38	1614
<u>Cotton</u>	7.8	18.5ab	3.1	8.6	70.3	5.32	1516
SAMCOT 10	13.3	21.5a	4.6	10.2	67.9	6.00	1599
SAMCOT 9	2.75	1.87	0.54	0.95	7.50	0.30	89.12
Sole maize							
SE±							

1 Plot size = m^2

2 WAS = Weeks after sowing

3 Means followed by the same letter(s) are not significantly different at P = 0.05 and 0.01 levels

Table 2: Effects of variety and trap-cropping on *Striga* infestation and incidence, yield and yield components of maize at Bagauda during the 1997 wet season

Maize varieties	*Striga* count/plot[1]		Crop plant infested /plot		Maize plant count		Grain yield [Kg/ha]
	12WAS[2]	Harvest	12WAS	Harvest	Cob No/ plot	Weight (kg/plot)	
9021-18 (Oba super 1)	17.6ab[3]	81.7ab	4.6a	11.9ab	59.5a	6.08a	2316a
9022-13	11.6ab	88.9a	4.2a	17.3a	56.9a	6.70a	2573a
Acr.93TZLComp.1-W	4.2b	20.5b	1.6b	5.5b	47.6a	6.08a	2318a
TZESRW	8.5ab	105.9a	3.7ab	16.3a	37.4b	3.66b	1235b
8338-1	22.4a	110.5a	5.7a	14.3ab	32.4b	3.39b	1508b
SE±	3.82	16.06	0.57	1.99	2.31	0.33	138.20
Trap Crop Cultivars	13.4	72.8	4.2	12.5	47.1	4.97	1865b
Cotton	15.2	70.5	4.0	12.2	43.3	5.06	1859b
SAMCOT 10	10.4	84.0	3.3	12.1	46.9	5.29	2351a
SAMCOT 9	2.51	10.87	0.44	1.14	2.08	0.34	105.85
Sole maize							
SE±							

1 Plot size = $18m^2$

2 WAS = Weeks after sowing

3 Means followed by the same letter(s) are not significantly different at P = 0.05 and 0.01 levels

Table 3: Effects of variety and trap-cropping on *Striga* infestation and incidence, yield and yield components of maize at Samaru during the 1998 wet season.

	Striga count/plot[1]			Maize				
Maize varieties	9 WAS[2]	12 WAS	Harvest	Crop reaction score 9 WAS	Stand count x000/ha	Cob number x000/ha	Cob yield (kg/ha)	Grain yield (kg/ha)
9021-18 (Oba super 1)	4.5c[3]	30.6c	37.1d	2.71c	22.38b	31.68ab	3966a	1500ab
9022-13	22.9c	71.8b	78.8b	3.14b	24.95a	34.29a	4087a	1763a
TZL comp.1C4	4.7c	31.9c	36.8d	3.00b	25.23a	34.17a	3379a	1593ab
8338-1	6.4c	44.6c	51.9c	3.19b	24.41a	29.22b	3750b	1169c
TZESRW	35.6a	108.8a	117.7a	4.81a	25.42a	34.90a	2508b	1438bc
SE±	4.15	9.00	9.30	0.18	1.36	1.16	305.15	115.15
<u>Trap Crop Cultivars</u>	9.3	42.2b	55.1b	3.20	33.81a	33.81a	3800a	1703
<u>Cotton</u>	18.0	65.6a	75.3a	3.40	35.86a	35.86a	3669ab	1598
SAMCOT 10	15.1	59.0ab	61.1ab	3.33	27.83b	27.83b	2663b	1428
SAMCOT 9	3.45	4.20	4.20	0.08	0.99	1.86	239..00	88.05
Sole maize								
SE±								

1 Plot size = $15m^2$

2 WAS = Weeks after sowing

3 Means followed by the same letter(s) are not significantly different at P = 0.05 and 0.01 levels

Table 4: Effects of variety and trap-cropping on *Striga* infestation, yield and yield components of maize at Bagauda during the 1998 wet season.

Treatments			Maize			
	Striga count/plot $9m^2$ [1]		Plant count No x000/ha	Cob		Grain yield (kg/ha)
Maize varieties	10 WAS[2]	Harvest		Count No x000 /ha	Weight kg/ha	
9021-18 (Oba super 1)	7.9b[3]	12.4b	3968c	39.79ab	2433a	2215a
9022-13	10.5ab	14.4ab	40.95a-c	43.09a	2528a	2268a
TZL comp. 1C3	7.8b	11.7b	39.09bc	34.93b	1947b	1549b
8338-1	9.2b	12.8b	41.62ab	35.80b	1924b	1361b
Mega white	13.4a	17.4a	42.42a	38.14ab	2001b	1312b
SE±	0.95	1.04	0.77	2.00	99.80	93.15
Trap Crop Cultivars	9.4	11.9	40.04	38.00	2118	1607
Cotton	8.5	13.4	41.25	40.07	2174	1769
SAMCOT 10	6.9	10.6	40.55	40.81	2243	1759
SAMCOT 9	1.31	1.26	1.26	1.25	74.45	69.95
Sole maize						
SE±						

1 Plot size = $9m^2$

2 WAS = Weeks after sowing

3 Means followed by the same letter(s) are not significantly different at P = 0.05 and 0.01 levels